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AUTHOR Shale, Doug; Garrison, D. Randy
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ABSTRACT

An audioteleconferencing system enhanced with a microcomputer-based telewriting system was used for the delivery of an introductory statistics course designed for home study which was offered by Athabasca University. From the instructor's point of view, the telewriter system made supporting the delivery of the statistics course much easier and more convenient than was possible by using either the telephone or teleconferencing alone. However, a number of technical problems with the telewriter system were cited by all students as a major problem throughout the project. Instructionally, the students were dissatisfied with the lecture style of presentation used by the instructor and with the rate of pacing used to cover the course content. Students particularly questioned the reproduction of material given in the text and student manual. In fact, many felt that they could progress as well reading the material on their own, at home, and to a large degree this would account for the substantial fall-off in attendance at sessions at the six study sites, and the termination of the course with a 67% completion rate. Students indicated that two of their initial expectations for the course--personal contact with the instructor and personal contact with other students--were not met. Possible explanations for the overall negative assessments of this course include a negative reaction to the instructor and the associated instructional style, the technical problems experienced, and the nature of the subject matter. (7 references) (GL)

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EVALUATING A TELEWRITER SYSTEM TO ENHANCE AUDIO-TELECONFERENCING: A QUALITATIVE SEARCH FOR INSTRUCTIONAL DESIGN ISSUES

Doug Shale
Office of Institutional Analysis
The University of Calgary

D. Randy Garrison
Faculty of Continuing Education
The University of Calgary

Teleconferencing uses various forms of telecommunications technology to reduce the dependency on print material and mail delivery that is characteristic of correspondence education, the traditional form of distance education. While teleconferencing students may lose some of the independence they would have in correspondence study, they gain the advantage of being able to interact immediately with a teacher and with fellow students.

From the educational institution's point of view, the success of audio teleconferencing, the most common form of teleconferencing, is due to the range of instructional approaches it supports and the immediacy and quality of educational exchanges between teacher and students. In addition, audio teleconferencing has proven to be a cost-effective telecommunications technology (largely because it uses existing existing dial-up telephone lines). While audio communication support with print materials could be satisfactory for many courses, other courses require a visually interactive means of communication analogous to the blackboard in traditional classroom instruction.

The purpose of this paper is to describe an audio teleconferencing system enhanced with a microcomputer based telewriting system and to examine its effects on the delivery of an introductory course in Statistics offered by Athabasca University. The aim is to provide a greater recognition and understanding of enhanced audio teleconferencing as a distance delivery technology.

Telewriting-Enhanced Audio Teleconferencing

The viability and usefulness of audio teleconferencing is apparent from the significant number of institutions in Canada using this technology (Knowles, 1984). Currently in Alberta, the vast majority of colleges and universities are involved in teleconferencing. Alberta's unique audio teleconferencing system allows institutions to deliver courses to approximately 45 centres over toll-free lines.

These indications of success notwithstanding, audio teleconferencing has had a considerable period of gestation since the initial development of the technology in the early 1960's. While the strength of audio-teleconferencing is its two-way communication capability, clearly its most glaring and sometimes critical deficiency is an inability to support visual instructional interaction. At the present time the most versatile and cost-effective way to address this deficiency appears to be with a microcomputer based telewriting system.

The telewriting system used in the study reported here has the unique capability of supporting simultaneous aural and visual communication. The system uses a graphics tablet and keyboard on which the instructor can write or type a message which is transmitted immediately with audio communication along a single telephone line. At all of the centres in the system, students can receive handwritten text and/or typed text and/or graphic messages on a colour monitor. Each centre also has the capability of altering images that have been

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sent out, using a cursor (or pen) to point out features on these images, or creating and transmitting images themselves. All messages and images may be viewed simultaneously in all centres in real-time. In addition, the system is able to support the transmission of computer messages between teleconference sessions, computer-based learning, and computer graphics. With some additional hardware it could also support freeze-frame and other ancillary media.

The system used in the project is based on Optel Communications' Telewriter II - PC's using an IBM XT PC. The Optel hardware consists of a graphics tablet, software and a "Voice-Too" modem. The Voice-Too modem is the key feature that allows for the concurrent transmission of voice (at 300 baud) and data on one standard telephone line. There is a second, asynchronous modem (the IDEACOMM modem) internally installed in the microcomputer which may be used to download screen pages directly from centre to centre (at a 1200-2400 baud rate).

Using this system, instructors and students physically distant from one another have a unique opportunity to discuss and explain problems both aurally and visually - a process that closely simulates the conventional educational process.

The Project

The application of the telewriting system described here was a pilot project that directly involved Athabasca University (who provided the course, the students and the instructor) and The University of Calgary (who provided the telewriting system and technical support). The course delivered was AU's introductory course in statistics; initially, there were six sites in the telewriting system (the instructor was linked to these six through another site located at The University of Calgary); nineteen students started the course, with two centres serving only a single student each; another centre had two students; and the other three centres had about five students each. The major object of the project was to give the telewriting system, itself, a thorough test and to obtain some solid experience on how to use the technology effectively to support the instructional process.

The statistics course was designed as a home study course. The materials sent to students in the pilot project were identical to those used by home-study students. The home-study students are supported by a telephone tutor who they can call (collect) during the week (usually at a set time on one prescribed day). In the pilot project, primary support was intended to be via the telewriter system; however, the students were also given the opportunity to phone the instructor directly after each week's session, and on other occasions as well. Thirteen, 2-hour sessions were scheduled for the Fall term of 1987.

The instructor for the pilot project had experience supporting the statistics course by both telephone tutoring and audio-teleconferencing. As a consequence of this experience, the instructor was acutely aware that there were likely to be enormous differences among the students in the pilot project with respect to ability, math preparation and motivation. As a result of the teleconferencing experience, the instructor was aware that students typically came to sessions unprepared for the evening's content. To a large degree, this experience influenced many of the decisions made regarding the instructional design issues that were encountered. In addition, because the system was experimental considerable redundancy was built into the teleconference session just in case "something" went wrong.

Extensive use was made of prepared screens which were used just as one might use an overhead projector (for example, sequentially stepping through problems, presenting of information and formulae. It was also possible to annotate the prepared screens (for example, using the pen and pad one could manually fill in some of the numbers just to illustrate the detail of the computation, and then skip to the next screen which would have all the values neatly typed in place). The pen and pad were also invaluable in creating extemporaneous screens that elaborated on material presented orally - particularly when symbols and formulae were involved.

In any given session, the instructor had to coordinate himself, the telewriter screen (with prepared pages or as a blackboard), the course materials and, of course, the students. As a result, each session needed considerable planning and the instructor found it necessary to do some "scripting" and rehearsing.

With respect to course content (and its presentation), the telewriter was used: (1) to step through solutions to problems; (2) to present content in note-like, abbreviated form; and (3) to illustrate, visually, points of elaboration and to work through questions and problems spontaneously. The first two applications required advance preparation of screens which were stored on floppy disk and sent to the centres where they were down-loaded to the PC's. Creating these screens was quite time consuming. Consequently, they had to be prepared well in advance. This meant that the content and sequencing had to be fixed well in advance of the sessions. As a result, sessions were pre-scripted to a high degree.

The use of the pen and screen in chalk and blackboard fashion was relatively easy and a more nearly normal act. It was ideal for elaboration through visual illustration - and, in fact, indispensable for limited graphics and symbolic representations. However, there were some limitations here as well. In particular, the screen is quite a limited display area, and advanced preparation of pages (using the keyboard) enabled optimal use of the area; the alternative of using the pen in free-hand style reduced legibility and usually lead to a fragmentation of material over screens (a serious problem when you have to carry figures from one screen to the next; you almost have to write the numbers on paper before continuing. Also, with prepared screens, you can flip back and forth; you cannot do this easily with pen created screens). As a result, a lot of advance work on lesson planning and preparation is required to use the system effectively and efficiently.

To make all this work, the instructor needs to operate cognitively at two levels - the obvious one of dealing with the content and communicating with students, and the other dealing with the mechanics of how to use the pen and pad (and related matters around it, such as remembering not to lay the pen on the pad, and that students cannot see where you are pointing with the pen unless you switch to "point" mode, and so on).

Garrison (1985) points out that teleconferencing is a unique technology for supporting the distance delivery of education because it so closely emulates the usual real-time, two-way educational exchange between teacher and student(s). Capitalizing on this feature was a major instructional conundrum in this project. When the instructional situation is based on natural language and relies to a large extent on "general" knowledge topics, then it is usually possible to initiate a discussion in which everyone can participate at some level. With mathematical subject matter, however, discussion is more

difficult: first of all, the material is mostly factual and inherently highly structured and not really amenable to discussion - consequently, communication is more likely to be of a question-answer nature. Second, all those party to a session must have acquired some familiarity and ease with the symbolic system used as the primary language of communication - as well as having a satisfactory understanding of the concepts underlying the symbol. For example, when a student sees the symbol "Σ" for the first time, they have no ready natural language term for it until they are told it is the Greek letter sigma; they then have no meaning to associate with the letter until they learn that the symbol means "sum up a set of numbers"; and until all students have this commonality of understanding, it is impossible to consider collectively computational formulae that use quantities like ΣX^2 or $(\Sigma Y)^2$, and so on. The more heterogeneous the group of students, the more severe the problem becomes - and this is particularly the case for the students of the pilot project (because there are no pre-requisites for the course, students vary enormously in their aptitudes and preparation). As a consequence, it was very difficult to initiate and maintain interactive exchanges - and perhaps this was partly why there turned out to be very little interaction in the course. Certainly, using the sessions for lecture style presentations exacerbated the problem of too much lecturing and too little student participation.

Results and Discussion

From an instructor/tutoring point of view, the telewriter system used in the project made supporting the delivery of the statistics course much easier and more convenient than was possible either by using only the telephone or only teleconferencing. In retrospect, instructionally it was a mistake to fall into the trap of lecturing during the sessions (and, again, this was done because students did not seem to come prepared for the evening's agenda; the great lengths of silence that ensued when the students were asked direct questions and when they were asked if they had any questions also did not promote two-way communication). Some lecturing lead to more lecturing and more apparent passivity among the students; and in addition this lead to psychological pressure to cover all the course material - this, in turn, resulted in a rate of pacing that students found difficult to keep up with. In spite of repeated invitations to students to ask questions and respond to specific inquiries, student interaction was minimal. This was a cause for concern to the instructor and one of the major sources of dissatisfaction among students.

When the students started the course, they were given a questionnaire that asked about their expectations regarding the course and the telewriter system. The students were also asked to respond to the same questions after the course was completed in an attempt to assess the extent to which student expectations were met. In the event, student response to the after-course questionnaires was so poor, the students were phoned and interviewed.

Nineteen students started the course, one of whom transferred to home study after completing the first two of the six assignments marked for credit. Of the remaining 18, all of them completed assignment 1, 17 completed assignment 2, 15 completed assignment 3, 15 wrote the mid-term exam (and 5 of the 15 failed on their first attempt; 2 re-wrote and passed; only one of those failing

did not continue in the course and one of those passing also did not continue); 13 students continued after the first exam and all 13 completed all of the remaining 3 assignments. To date, 10 students have written the final exam 2 of whom failed; thus 8 students of the 18 starters (44%) have completed the course satisfactorily. However, 3 other students are in a position to write, 2 of whom can reasonably be expected to pass (10 out of 18 is 56%). If we exclude the three students who quit the course before getting half way through, then we can calculate the completion rate as 10 out of 15 (67%).

There were a number of technical problems with the telewriter system. For the first couple of sessions, the problems were largely associated with making the telewriters function properly. Subsequent problems had more to do with poor quality signal transmission. Technical problems were cited by all students as a major problem throughout the project. Instructionally, the majority of students were very dissatisfied with the lecture style of presentation and the rate of pacing required to "cover the course"; and they particularly questioned the reproduction of material given in the text and student manual (many felt they could progress as well reading the material themselves, at home, and to a large degree this would account for the substantial fall-off in attendance at the sessions; it should be emphasized that in this project, the students had available well-designed course materials - had this not been the case, they likely would have responded quite differently).

At the outset of the course, the students thought that the major advantages of studying statistics through the telewriter system would be: personal contact with an instructor; personal contact with other students; and pressure to keep up in the course (in that order of importance). Because of a lack of interaction in the sessions, at the end of the course the students did not feel they benefitted much in regard to personal contact with an instructor. It is worth noting also that the students rarely took advantage of repeated invitations to phone the instructor and discuss matters of concern to them. When asked why, most students replied they did not feel any need to. This is somewhat puzzling given their apparent dissatisfaction with the limited interaction in the sessions. Students also reported after the fact that there was limited student to student interactions (unlike what a number of them had experienced in other teleconference courses). This may be because study in mathematics is so structured that students must largely proceed in their own way and at their own pace. The students did confirm that regular classes and fixed assignment due dates helped them to work at the course on a regular basis and to complete it.

Many of the students did find the telewriter system helpful in some way - perhaps more than they may have realized and this may be why most students did not feel any need to use the phone sessions. However, over-all they did not seem to value the sessions very highly. This is in contrast to the favourable assessments made by eleven of the students in the project who had previously taken a course by teleconferencing. Moreover, the results stand in contrast to favourable reports of other telewriter experiences (Martin, 1986; Thompson, 1986; Maher, 1986). Interesting instructional questions arise as to why there is such a difference. An obvious possibility is that the result was confounded by negative reaction to the instructor and the associated instructional style, or by the technical problems experienced. Alternatively, it is possible that a different group of students might have reacted differently. Almost certainly,

the nature of the subject matter had the strongest effect on both instructional design considerations and student attitudes. It is clear the students did not find much value in the lecture-style presentations used during the sessions (given that they had a good home-study package). However, question and answer interaction did not work too well either (because students were at so many levels of ability and understanding, because of the significant amount of time required to work through a problem collectively, and because of apparent student reluctance to participate). The question that seems to remain is: "Can a telewriting enhanced teleconferencing system play a more effective role in supporting mathematics based courses and, if so, what is an optimal instructional strategy?" Clearly, promoting two-way interaction is critical, or else there is little benefit to using two-way communication technology. Whatever one chose to do, it would be essential to provide students with sufficient information to temper the expectations they bring to the situation. At a minimum students need to be aware that despite many similarities, telewriting sessions are different in important ways from going to a traditional "class" - and they need to know that mathematics delivered through telewriting/teleconferencing will be a very different kind of experience then is possible with courses largely based on natural language and common knowledge.

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